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09/418,029	10/14/1999	LAP CHAN	CS99-120	8308

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EXAMINER	
RAO, SHRINIVAS H	
ART UNIT	PAPER NUMBER
2814	

DATE MAILED: 01/16/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

# Office Action Summary

Application No.

09/418,029

Applicant(s)

CHAN ET AL.

Examiner

Steven H. Rao

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

## Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

## Status

- 1) ☒ Responsive to communication(s) filed on 18 December 2001.
- 2a) ☐ This action is **FINAL**.
- 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

## Disposition of Claims

- 4) ☒ Claim(s) 1-28 is/are pending in the application.
- 4a) Of the above claim(s) 25-28 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☐ Claim(s) 1-24 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) 1-28 are subject to restriction and/or election requirement.

## Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 14 January 1999 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.  
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

## Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).  
a) ☐ All b) ☐ Some \* c) ☐ None of:  
1. ☐ Certified copies of the priority documents have been received.  
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.  
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).  
\* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).  
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

## Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 2.

- 4) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_

### **DETAILED ACTION**

#### ***Priority***

No priority is presently claimed, therefore the filing date is the earliest available priority date i.e. October 14, 1999.

#### ***Information Disclosure Statement***

Acknowledgment is made of receipt of Applicant's Information Disclosure Statement (PTO-1449) filed December 06, 1999.

The references on PTO 1499 submitted on 12/06/1999 are acknowledged. All the cited references have been considered. However the foreign patents and documents cited by applicant are considered to the extent that could be understood from the abstract and drawings.

The initialed PTO-1449 indicating that the references cited on the above mentioned IDS have been considered is placed in the file. The Contract employees have been instructed to mail a copy of the initialed PTO-1449 along with instant Office Action.

#### ***Election/Restrictions***

Applicant's election with traverse of the election/restriction in Paper No. 4 is acknowledged. The traversal is on the ground(s) that the method claims necessarily use the product and vice versa. This is not found persuasive because for the reasons stated in the election/restriction requirement and incorporated here by reference clearly show that the method claims do not use the product. Further it is clear to one of

ordinary skill in the art that a multilevel interconnect structure need not have air gaps and instead use other dielectrics like insulating layers.

The Examiner reasoning that the devices can be made by another and materially different process, namely the second oxide layer can be grown by oxidation of the substrate is not speculative but based on text book knowledge of semiconductor art and the instant claim recitations using open ended language "comprising".

Lastly, the requested examining of both the device and method claims will result in undue burden on the office without any additional benefits to the applicant.

The requirement is still deemed proper and is therefore made FINAL.

### ***Specification***

The disclosure is objected to because of the following informalities: The Abstract as filed contains more than 150 words which is the new limit on the number of words allowed in an abstract.

Appropriate correction is required.

Claims are examined by examiner as best to understood.

### ***Claim Rejections - 35 USC § 112***

The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the

art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claim 15 is rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention. Claim 15 recites that the disposable solid layer (polymer) is removed by applying vacuum to the substrate which dissolves the disposable solid layer (polymer).

It is not understood how applying a vacuum to the substrate will dissolve the disposable solid layer.

Appropriate correction is required.

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claim 11 recites the limitation "said first network of nitride filled trenches" in line 14 there is insufficient antecedent basis for this limitation in the claim.

Claims 4 and 5 recite " under an angle of 90 degrees" It is not clear what applicants' mean by under an angle of 90 degrees.

Appropriate corrections are required

***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

A. Claims 1-8, 11, 16-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Katoh ( U.S. Patent No. 5,141,896 herein after Katoh).and Ito ( U.S. Patent No. 6,297,1145, herein after Ito).

With respect to Claims 1 and 11 ( to the extent understood), Katoh describes a method of forming air gaps between metal leads of a semiconductor device, including : providing a semiconductor substrate having electrical contacts on its surface ( Katoh fig. 2a # 20-substrate, electrical contacts is where interconnect # 2 contacts the substrate 20); forming a first network of nitride filled trenches in a first level dielectric that is deposited on the surface of the substrate ( fig. 2b # 4,col. 4 lines 25-28);

Katoh does not specifically mention that trenches are filled with nitride but instead mentions filling the trench with an organic insulating film.

However within the same field of endeavor, Ito in figs. # 3 a -c, col. 8 lines 1-2 teaches forming nitride filled trenches to form insulators that can withstand higher temperatures that is greater than 400 degrees.

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to substitute Ito's inorganic i.e. nitride filled trenches for Katoh's organic insulating film filled trenches so that the filled trenches can with stand higher temperatures during further processing e.g. higher than 400 degrees.

Forming a second network of nitride filled trenches in a second level of dielectric having been deposited on the surface of the first level of dielectric whereby furthermore

the second network of nitride filled trenches is in physical contact with and intersects with the first network of nitride filled trenches. (Ito, figs. 4 a-c 3 17 and fig. 13 first (106) and second level (108) intersect each other); depositing a thin oxide layer over the surface of the second layer dielectric (Ito fig. 19 # 105, col. 1 line 67); etching openings in the first thin oxide layer, it (openings) being aligned to the intersects between the first and second nitride filled trenches (Ito fig. 13); removing nitride from the first and second network ( Ito fig. 13) and depositing a second thin layer of oxide over the surface of the first thin oxide layer thereby closing the openings in the first oxide layer ( Ito fig. 13 # 109).

Claim 11 recites that the trenches are filled with a disposable solid layer instead of reciting that they ( trenches) are filled with a nitride ( as in claim 1) however as stated above the disposable solid layer is not specified and therefore the only disclosure is nitride.

With respect to claims 2 and 3, wherein the first and second network of nitride filled trenches includes : depositing a dielectric over the substrate ( Ito fig. 2 a # 3), patterning and etching the first layer of dielectric thereby creating a first network of trenches in the first dielectric layer ( Ito fig. 2 b, col. 7 lines 41-45); depositing a first layer of nitride over the surface of the first layer of dielectric thereby including the first network of trenches ( Ito fig. 2 b, # 4) and polishing the first nitride layer to remove the first nitride layer from the surface of the first dielectric layer ( fig. 2 b --see areas 9 and 10). Claim 3 recites the same procedure for the second level dielectric layer ( Ito figs. 3ba- 3c).

With respect to claims 4 and 5 to the extent understood, wherein the first and second trench networks intersect "under" an angle of 90 degrees. (Ito see fig. 13, Katoh fig. 1).

With respect to claim 6, wherein the first and second oxide layer thickness are extended to create high aspect ratio openings (Ito fig. 2 c, col. 7 lines 49-61).

With respect to claims 7 and 8, wherein a network of metal interconnect lines on the extended oxide surface (Ito figs. 4a-c # 2 and 17).

Claim 16 repeats the steps of claim 4, claim 17 repeats the steps of claim 5, Claim 18 repeats the steps of claim 6, claim 19 repeats the steps of claim 7, claim 20 repeats the step of claim 8 and the above mentioned respective rejections are incorporated here by reference and claims 16, 17, 18 and 19 are rejected for the same reasons.

**B.** Claims 9-10, 12-15, 21-24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Katoh (U.S. Patent No. 5,141,896 herein after Katoh) and Ito (U.S. Patent No. 6,297,1145, herein after Ito) as applied to claims 1-8 and 11 above, and further in view of Havemann et al. (U.S. Patent No. 5,461,003, herein after Havemann).

With respect to claims 9 and 10, wherein the dielectrics are baked at 150-300 degrees and cured above 300 degrees.

Katoh and Ito teach the treatment of dielectrics but do not specifically mention the temperatures 150-300 and above 300 degrees.



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However, within the same field of endeavor Havemann describes in col. 5 lines 47-55) the treatment of dielectrics above 100 degrees to remove the disposable polymer solid layer.

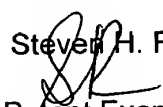
Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to include Havemann's temperature range of above 100 degrees to remove the disposable polymer solid layer. (Havemann col. 5 lines 45-55).

With respect to claims 12-15, wherein the solid disposable layer is a polymer (Havemann col 5 line 30) and is removed by exposing to Oxygen plasma (Havemann col. 5 lines 49-50), by solvent (Havemann col. 7 lines 8-10), by heating (Havemann col. 5 lines 57-60), and vacuum (to the extent understood col. 7 lines 12-15).


Claim 21 repeats the steps of claim 9, claim 22 repeats the steps of claim 10 the above mentioned respective rejections are incorporated here by reference and the claims 21,22 are rejected for the same reasons.

With respect to claim 23, it recites all the steps of claims 1 and 11 and further adds that the metal layer is etched to form metal leads in y-direction (Havemann col. 5 lines 24-26, fig. 1 A) and the trenches in X and Y-directions (Ito 13, etc.).

Claim 24 repeats the steps of claims 4,5,16 and 17 and is rejected for the same reasons as set out above under claims 4,5,16 and 17 and incorporated here by reference.

  
Steven H. Rao  
Patent Examiner

January 10, 2002.

  
V. H. Chaturvedi